

WE CLAIM:

1. A method of determining and displaying risk information in response to a plurality of
5 input data, said input data including a plurality of input data calculation results,
comprising the steps of:
- comparing each calculation result of said plurality of input data calculation results of said
input data with each logical expression of a plurality of logical expressions;
10 ranking by said logical expression said calculation result; and
- generating a plurality of ranked individual risks in response to the ranking step, each of
said plurality of ranked individual risks representing an input data calculation result that
15 has been ranked by said logical expression as having either a high risk severity or a
medium risk severity or a low risk severity;
- generating said risk information in response to said plurality of ranked individual risks;
and
20 displaying said risk information, the displaying step including displaying said risk
information on a risk information display, said risk information display including a
display of said plurality of ranked individual risks as a function of depth in a wellbore.
- 25 2. The method of claim 1, wherein each of said plurality of ranked individual risks
displayed on said risk information display as a function of depth in said wellbore include
a severity, said severity including either said high risk severity or said medium risk
severity or said low risk severity, a color representing each said severity.
- 30 3. The method of claim 1, wherein each of said plurality of ranked individual risks
displayed on said risk information display as a function of depth in said wellbore include

a severity, said severity including either said high risk severity or said medium risk severity or said low risk severity, a numerical value representing each said severity.

4. The method of claim 1, wherein said risk information displayed on said risk
5 information display comprises one or more ranked subcategory risks.

5. The method of claim 4, wherein said risk information displayed on said risk
information display includes said one or more ranked subcategory risks as a function of
depth in said wellbore.

10

6. The method of claim 5, wherein each of said one or more ranked subcategory risks
displayed on said risk information display as a function of depth in said wellbore includes
a severity, said severity including said high risk severity or said medium risk severity or
said low risk severity, said severity being represented on said risk information display as a
15 color.

7. The method of claim 5, wherein each of said one or more ranked subcategory risks
displayed on said risk information display as a function of depth in said wellbore includes
a severity, said severity including said high risk severity or said medium risk severity or
20 said low risk severity, said severity being represented on said risk information display as a
numerical value.

8. The method of claim 5, wherein said subcategory risks is selected from a group
consisting of: gains risks, losses risks, stuck pipe risks, and mechanical risks.

25

9. The method of claim 1, wherein said risk information displayed on said risk
information display comprises one or more risk categories.

10. The method of claim 9, wherein said one or more risk categories includes a total risk, said risk information display including said total risk displayed on said risk information display as a function of depth in said wellbore.
- 5 11. The method of claim 9, wherein said risk categories are selected from a group consisting of: an average individual risk, a subcategory risk, an average subcategory risk, a total risk, an average total risk, a potential risk for each design task, and an actual risk for each design task.
- 10 12. The method of claim 11, wherein said risk information displayed on said risk information display includes said total risk as a function of depth in said wellbore.
13. The method of claim 12, wherein each said total risk displayed on said risk information display includes a severity, said severity including said high risk severity or
15 said medium risk severity or said low risk severity, each said severity being represented on said risk information display as a color.
14. The method of claim 12, wherein each said total risk displayed on said risk information display includes a severity, said severity including said high risk severity or
20 said medium risk severity or said low risk severity, each said severity being represented on said risk information display as a numerical value.
15. The method of claim 1, wherein said individual risk values are selected from a group consisting of: H2S and CO2, Hydrates, Well water depth, Tortuosity, Dogleg severity,
25 Directional Drilling Index, Inclination, Horizontal displacement, Casing Wear, High pore pressure, Low pore pressure, Hard rock, Soft Rock, High temperature, Water-depth to rig rating, Well depth to rig rating, mud weight to kick, mud weight to losses, mud weight to fracture, mud weight window, Wellbore stability window, wellbore stability, Hole section length, Casing design factor, Hole to casing clearance, casing to casing clearance, casing
30 to bit clearance, casing linear weight, Casing maximum overpull, Low top of cement,

Cement to kick, cement to losses, cement to fracture, Bit excess work, Bit work, Bit footage, bit hours, Bit revolutions, Bit Rate of Penetration, Drillstring maximum overpull, Bit compressive strength, Kick tolerance, Critical flow rate, Maximum flow rate, Small nozzle area, Standpipe pressure, ECD to fracture, ECD to losses, Gains, Gains Average, Losses, Losses average, Stuck, Stuck average, Mechanical, Mechanical average, Risk Average, Subsea BOP, Large Hole, Small Hole, Number of casing strings, Drillstring parting, and Cuttings.

16. A method of determining and displaying risk information in response to a plurality of input data, said input data including a plurality of input data calculation results, comprising the steps of:

comparing each calculation result of said plurality of input data calculation results of said input data with each logical expression of a plurality of logical expressions;

ranking, by said logical expression, each said calculation result; and

generating a plurality of ranked individual risks in response to the ranking step, each of said plurality of ranked individual risks representing an input data calculation result that has been ranked by said logical expression as having either a high risk severity or a medium risk severity or a low risk severity;

generating a plurality of design tasks in response to said ranked individual risks; and

displaying said risk information in response to said plurality of design tasks, the displaying step including displaying a risk information display, said risk information display including a display of each of said design tasks.

17. The method of claim 16, wherein each of said design tasks include an actual risk and a potential risk, and wherein said display of each of said design tasks on said risk

information display includes a display of said actual risk associated with each of said design tasks and a display of said potential risk associated with each of said design tasks.

18. The method of claim 17, wherein said display of each of said design tasks on said risk information display further includes a plot comprising said actual risk on one axis
5 and said potential risk on another axis and a display of each said design task on said plot.

19. A method of determining and displaying risk information in response to a plurality of input data, said input data including a plurality of input data calculation results,
10 comprising the steps of:

comparing each calculation result of said plurality of input data calculation results of said input data with each logical expression of a plurality of logical expressions;

15 ranking, by said logical expression, each said input data calculation result; and

generating a plurality of ranked individual risks in response to the ranking step, each of said plurality of ranked individual risks representing an input data calculation result that has been ranked by said logical expression as having either a high risk severity or a
20 medium risk severity or a low risk severity;

generating said risk information in response to said plurality of ranked individual risks;
and

25 displaying said risk information, the displaying step including displaying a risk information display, said risk information display including a display of said plurality of said ranked individual risks extending along a length of a wellbore.

20. The method of claim 19, wherein said display of said plurality of ranked individual
30 risks extending along a length of a wellbore includes a three-dimensional display of a

corresponding plurality of cylinders extending along a length of said wellbore, each of said cylinders representing one of said plurality of ranked individual risks.

21. The method of claim 20, wherein each of said cylinders which represent one of said ranked individual risks has a color, said color representing a severity of said one of said ranked individual risks.

22. The method of claim 20, wherein each of said cylinders which represent one of said ranked individual risks has a size, said size representing a severity of said one of said ranked individual risks.

23. A program storage device readable by a machine tangibly embodying a program of instructions executable by the machine to perform method steps for determining and displaying risk information in response to a plurality of input data, said input data including a plurality of input data calculation results, said method steps comprising:

comparing each calculation result of said plurality of input data calculation results of said input data with each logical expression of a plurality of logical expressions;

ranking by said logical expression said calculation result; and

generating a plurality of ranked individual risks in response to the ranking step, each of said plurality of ranked individual risks representing an input data calculation result that has been ranked by said logical expression as having either a high risk severity or a medium risk severity or a low risk severity;

generating said risk information in response to said plurality of ranked individual risks; and

displaying said risk information, the displaying step including displaying said risk information on a risk information display, said risk information display including a display of said plurality of ranked individual risks as a function of depth in a wellbore.

5 24. The program storage device of claim 23, wherein each of said plurality of ranked individual risks displayed on said risk information display as a function of depth in said wellbore include a severity, said severity including either said high risk severity or said medium risk severity or said low risk severity, a color representing each said severity.

10 25. The program storage device of claim 23, wherein each of said plurality of ranked individual risks displayed on said risk information display as a function of depth in said wellbore include a severity, said severity including either said high risk severity or said medium risk severity or said low risk severity, a numerical value representing each said severity.

15 26. The program storage device of claim 23, wherein said risk information displayed on said risk information display comprises one or more ranked subcategory risks.

20 27. The program storage device of claim 26, wherein said risk information displayed on said risk information display includes said one or more ranked subcategory risks as a function of depth in said wellbore.

25 28. The program storage device of claim 27, wherein each of said one or more ranked subcategory risks displayed on said risk information display as a function of depth in said wellbore includes a severity, said severity including said high risk severity or said medium risk severity or said low risk severity, said severity being represented on said risk information display as a color.

30 29. The program storage device of claim 27, wherein each of said one or more ranked subcategory risks displayed on said risk information display as a function of depth in said

wellbore includes a severity, said severity including said high risk severity or said medium risk severity or said low risk severity, said severity being represented on said risk information display as a numerical value.

5 30. The program storage device of claim 27, wherein said subcategory risks is selected from a group consisting of: gains risks, losses risks, stuck pipe risks, and mechanical risks.

10 31. The program storage device of claim 23, wherein said risk information displayed on said risk information display comprises one or more risk categories.

15 32. The program storage device of claim 31, wherein said one or more risk categories includes a total risk, said risk information display including said total risk displayed on said risk information display as a function of depth in said wellbore.

20 33. The program storage device of claim 31, wherein said risk categories are selected from a group consisting of: an average individual risk, a subcategory risk, an average subcategory risk, a total risk, an average total risk, a potential risk for each design task, and an actual risk for each design task.

25 34. The program storage device of claim 33, wherein said risk information displayed on said risk information display includes said total risk as a function of depth in said wellbore.

30 35. The program storage device of claim 34, wherein each said total risk displayed on said risk information display includes a severity, said severity including said high risk severity or said medium risk severity or said low risk severity, each said severity being represented on said risk information display as a color.

36. The program storage device of claim 34, wherein each said total risk displayed on said risk information display includes a severity, said severity including said high risk severity or said medium risk severity or said low risk severity, each said severity being represented on said risk information display as a numerical value.

5

37. The program storage device of claim 23, wherein said individual risk values are selected from a group consisting of: H2S and CO2, Hydrates, Well water depth, Tortuosity, Dogleg severity, Directional Drilling Index, Inclination, Horizontal displacement, Casing Wear, High pore pressure, Low pore pressure, Hard rock, Soft

10 Rock, High temperature, Water-depth to rig rating, Well depth to rig rating, mud weight to kick, mud weight to losses, mud weight to fracture, mud weight window, Wellbore stability window, wellbore stability, Hole section length, Casing design factor, Hole to casing clearance, casing to casing clearance, casing to bit clearance, casing linear weight, Casing maximum overpull, Low top of cement, Cement to kick, cement to losses, cement
15 to fracture, Bit excess work, Bit work, Bit footage, bit hours, Bit revolutions, Bit Rate of Penetration, Drillstring maximum overpull, Bit compressive strength, Kick tolerance, Critical flow rate, Maximum flow rate, Small nozzle area, Standpipe pressure, ECD to fracture, ECD to losses, Gains, Gains Average, Losses, Losses average, Stuck, Stuck average, Mechanical, Mechanical average, Risk Average, Subsea BOP, Large Hole, Small
20 Hole, Number of casing strings, Drillstring parting, and Cuttings.

38 37. A program storage device readable by a machine tangibly embodying a program of instructions executable by the machine to perform method steps for determining and displaying risk information in response to a plurality of input data, said input data
25 including a plurality of input data calculation results, said method steps comprising:

comparing each calculation result of said plurality of input data calculation results of said input data with each logical expression of a plurality of logical expressions;

30 ranking, by said logical expression, each said calculation result; and

generating a plurality of ranked individual risks in response to the ranking step, each of
said plurality of ranked individual risks representing an input data calculation result that
has been ranked by said logical expression as having either a high risk severity or a
5 medium risk severity or a low risk severity;

generating a plurality of design tasks in response to said ranked individual risks; and

displaying said risk information in response to said plurality of design tasks, the
10 displaying step including displaying a risk information display, said risk information
display including a display of each of said design tasks.

39
18. The program storage device of claim 37, wherein each of said design tasks include an
actual risk and a potential risk, and wherein the display of each of said design tasks on
15 said risk information display includes a display of said actual risk associated with each of
said design tasks and a display of said potential risk associated with each of said design
tasks.

40
39. The program storage device of claim 38, wherein said display of each of said design
20 tasks on said risk information display further includes a plot comprising said actual risk
on one axis and said potential risk on another axis and a display of each said design task
on said plot.

41
40. A program storage device readable by a machine tangibly embodying a program of
25 instructions executable by the machine to perform method steps for determining and
displaying risk information in response to a plurality of input data, said input data
including a plurality of input data calculation results, said method steps comprising:

comparing each calculation result of said plurality of input data calculation results of said
30 input data with each logical expression of a plurality of logical expressions;

ranking, by said logical expression, each said input data calculation result; and

5 generating a plurality of ranked individual risks in response to the ranking step, each of
said plurality of ranked individual risks representing an input data calculation result that
has been ranked by said logical expression as having either a high risk severity or a
medium risk severity or a low risk severity;

10 generating said risk information in response to said plurality of ranked individual risks;
and

displaying said risk information, the displaying step including displaying a risk
information display, said risk information display including a display of said plurality of
said ranked individual risks extending along a length of a wellbore.

15 **42**
41. The program storage device of claim 40, wherein said display of said plurality of
ranked individual risks extending along a length of a wellbore includes a three-
dimensional display of a corresponding plurality of cylinders extending along a length of
said wellbore, each of said cylinders representing one of said plurality of ranked
20 individual risks.

43
42. The program storage device of claim 41, wherein each of said cylinders which
represent one of said ranked individual risks has a color, said color representing a severity
of said one of said ranked individual risks.

25 **44**
43. The program storage device of claim 41, wherein each of said cylinders which
represent one of said ranked individual risks has a size, said size representing a severity
of said one of said ranked individual risks.